RISKS AND RISK MANAGEMENT IN BUILDING CONSTRUCTION PROJECTS FROM CONTRACTORS PERSPECTIVE IN ADDIS ABABA

By

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DECLARATION

I hereby declare that this thesis entitled "**Risks and Risk Management in Building Construction Projects from Contractors Perspective in Addis Ababa**" was composed by myself ,with the guidance of my advisor ,that the work contained herein is my own except where explicitly stated otherwise in the text ,and that this work has not been submitted ,in whole or in part ,for any other degree or professional qualification .

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CERTIFICATE

This is to certify that the thesis prepared by Mr. **Ermias Hailu** entitled **"Risks and Risk Management in Building Construction Projects from Contractors Perspective in Addis Ababa**" and submitted in fulfillment of the requirements for the degree of Master of Business Administration complies with the regulations of the university and meets the accepted standards with respect to originality and quality

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ABBREVIATIONS

CM-Construction Management

PMBOK – Project Management Body of Knowledge

PMI – Project Management Institute

RM – Risk management

ABSTRACT

Construction is a risky industry and there is no other industry requires proper application of business practices much as construction industry. The main objective of this research is to gain understanding of key risk factors that could face building construction projects in Addis Ababa and also to investigate the effectiveness of risk preventive and mitigative methods. This research has been achieved through a comparative study of questionnaires and interviews in Addis Ababa. The results of analyzing the 35 questionnaires, that were directed to building contractor respondents concluded that the key risk factors are: financial failure of the contractor, inflation, closure, defective design and delayed payments on contract, legal disputes during the construction phase among the parties of the contract, resource management, poor communication between involved parties, unmanaged cash flow, and occurrence of accidents because of poor safety procedures ,still there are many risk factors that contractors could not allocate them on the party that should bear these factors' consequences. The study findings show that the building contractors suffer from lack of innovative methods to prevent or mitigate risks and do not utilize risk analysis techniques but depend broadly on direct judgment in estimating time and cost. Finally the results recommended that there is an essential need for more standardization and effective forms of contract, which address issues of clarity, roles and responsibilities, allocation of risks, dispute resolution and payment. Building contractors are called for identification of possible risk factors that could be faced and to allocate them contractually.

Key Words:-Risk, Risk Management, Building construction Project Risk Management, Risk Control, Risk Response Planning, Risk Identification, Risk Analysis

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CHAPTER 1: INTRODUCTION

1.1. Research background

Compared with many other industries, the construction industry is subject to more risks due to the unique features of construction activities, such as long period, complicated processes, uncomfortable environment, financial intensity and dynamic organization structures.

The construction industry generally has a bad reputation for its work. The industry has a reputation for time and cost overruns. This status is due to many reasons. One of them is that the construction industry is one of riskiest of all business types. There are many types of risks in the building construction contracts like physical works, delay and disputes, direction and supervision, damage and injury to persons and property, external factors, payment, law and arbitration.

Construction projects can be extremely complex and fraught with uncertainty. Risk and uncertainty can potentially have damaging consequences for the construction projects. Therefore, the risk analysis and management continue to be a major feature of the project management of construction projects in an attempt to deal effectively with uncertainty and unexpected events and to achieve project success.

Construction projects are always unique and risks arise from a number of the different sources. Construction projects are inherently complex and dynamic, and involving multiple feedback processes. A lot of participants – individuals and organizations are actively involved in the construction project, and their interests may be positively or negatively affected as a result of the project execution or project completion. Different participants with different experience and skills usually have different expectations and interests. This naturally creates problems and confusion for even the most experienced project managers and contractors.

Cost of risk is a concept many construction companies have never thought about despite the fact that it is one of the largest expense items. Risk management helps the key project participants – client, contractor or developer, consultant, and supplier – to meet their commitments and minimize negative impacts on construction project performance in relation to cost, time and quality objectives. Traditionally, practitioners have tended to associate construction project success with these three aspects of time, cost and quality outcomes.

The current economic downturn and challenges in a highly developing country like Ethiopia's construction sector require contractors to manage risks by themselves. An effective risk management method can help to understand not only what kinds of risks are faced, but also how to manage these risks in different phases of a project. Owing to its increasing importance risk management has been recognized as a necessity in most industries today. This paper reports the research aims to identify key risks, examine the risk analysis and risk management processes in the Addis Ababa construction projects.

1.2. Statement of the problem

The management of risks is a central issue in the planning and management of any project.

As the most common and typical project types, construction projects have several characteristics such as specific objects: time constraints, cost constraints, special organizational and legal conditions, complexity and systematic characteristics. For that, each investment project is a complex system, especially for the construction project. There are many risk factors and complicated relations, which will influence it. The complicated relationships include direct, indirect, obvious, implicit or unpredictable.

Risk factors will cause different severity of the consequences. If one doesn't consider these risk factors at all, or ignore the main factors, they will cause damage because of decision-making errors.

Quality targets, time targets, cost targets are the three major objectives of construction project management. Especially in the building construction projects, the time objective is closely and inseparably related to the cost objective. Therefore, we cannot ignore risk management of the effect on time objective caused by risks during construction phase.

This research is important, where it discovers the risk factors in the construction industry in Addis Ababa and determines the importance of each factor in terms of severity and allocation. Only by analyzing the influence, can we make a better predication and control of the schedule and ensure the project complete successfully.

Research on risk assessment and management has been done by various people, mostly on developed countries. In Ethiopia, only few research works have been done in this area, which focuses on general constructions including roads and dams. Other researchers also work on risk management from owners and insurances perspective. Thus to fill the gap this study focuses on risk management in field of building construction and from contractors perspective.

1.3. Objective of the research

General objective

This research sights on highlighting the key risks and risk management in building construction projects and identifies key risk variables and their effects on the building construction projects of Addis Ababa from the contractor's perspective. These risks are to be identified and mitigated to avoid the losses. This entire process of risk identification and mitigation is termed as risk management.

Specific objective

The specific objectives of this study are:

- ✓ Identifying key risk factors that the construction process faces.
- ✓ Investigating the severity of each identified risk factors.
- ✓ Allocating each identified risk factors on parties participating on the construction process.
- ✓ Examining the risk management actions efficiency that are applied in the industry.
- ✓ Providing practical suggestions and recommendations pointing toward upgrading the risk management process in construction and improve the performance of contracting companies.

1.4. Research questions

1. What are the key risks in building construction of Addis Ababa?
2. What is the severity of the identified risks from the contractors' perspective?
3. Where to allocate the risks, from the contractors' perspective?
4. How risks can be mitigated and controlled in building projects from contractors' perspective?

1.5. Scope of the Research

The scope of the research is limited to the building construction projects of Addis Ababa only and will not take into account that other categories of construction industry like heavy engineering construction (tunnels, bridges, dams, etc.), industrial projects (factories and workshops), road and infrastructure projects (sewage and water supply).Only locally registered Contractors are addressed by the study and above BC-3grade contractors are involved in the study.

1.6. Limitation of the Research

It is evident that research work is not free from mitigating or limiting factors. In the same nominal, there were various limitation factors witnessed in this study. Firstly, as the researcher is not a full time sponsor, he was obliged to discharge routine office assignments as desired, which imposed

additional duties and consumed the researcher's time? Secondly, some of the samples of the study, particularly contraction managers were so busy that they were not available in their office and unable to fill the questionnaires by giving adequate time as planned. Thirdly, to study on regional places which were impossible to include in the research due to time, distance and financial constraints as a result of which only those construction companies stationed in Addis Ababa city are included in the survey study.. Finally, to increase the values of this study, the need for comprehensive data and survey that is more extensive would have been helpful and as such future research along this line should focus on these limitations.

1.7. Significance of the Research

The risk management technique is used very less because of less knowledge and awareness among the people. The track record is also very poor in terms of coping up with risks in projects, resulting in the affection of project objectives. Risk management is adopted to contain the possible future risks proactively rather than being reactive. It applies to any project to evaluate the most, major, and common risks which cause bad effect on the construction project to achieve its objectives. The risk management concept is very less popular technique in the construction industry, and then it is necessary to spread awareness of the same.

CHAPTER 2:LITERATURE REVIEW

2.1. Introduction

Due to the nature of construction projects, risk management is a very important process. Risk management is a process which identifies the project risks, analyze them, and determine the actions to avert the threats on any project. Risk management is the process by which clients and their contractors' make decisions based on data generated in risk assessments. Risk management involves making intellectual decisions about different configurations, construction scenarios and operational parameters. Risk management is thus one of the most critical project management practices to ensure a project is successfully completed (Chapman, 1997). Royer (2000) stated:

Throughout the world, the construction industry has changed rapidly over the past decade; companies are now faced with more risk and uncertainty than before. Clients are more likely to engage in litigation when things go wrong. Risk in construction has been the subject of attention because of time and cost overruns associated with projects. As a result, risk can be defined as an uncertain event or condition that, if it occurs, has a positive or negative effect on a project objective. Jaffari (2000) defined risk as the exposure to loss, gain, or the probability of occurrence of loss/gain multiplied by its respective magnitude. Kartam (2001) has defined risk as the probability of occurrence of some uncertain, unpredictable and even undesirable events that would change prospects for the probability on a given investment.

2.2 Definition

Risk is a multi-facet concept. In the context of construction industry, it could be the likelihood of the occurrence of a definite event/factor or combination of events/factors which occur during the whole process of construction to the detriment of the project a lack of predictability about structure

outcome or consequences in a decision or planning situation, the uncertainty associated with estimates of outcomes there is a chance that results could be better than expected as well as worse than expected etc. In addition to the different definitions of risk, there are various ways for categorizing risk for different purposes too. Some categorize risks in construction projects broadly into external risks and internal risks while others classify risk in more detailed categories of political risk, financial risk, market risk, intellectual property risk, social risk, safety risk, etc. The classification is shown in the figure 2.1. The typology of the risks seems to depend mainly upon whether the project is local (domestic) or international. The internal risks are relevant to all projects irrespective of whether they are local or international. International projects tend to be subjected to the external risk such as unawareness of the social conditions, economic and political scenarios, unknown and new technical formalities, regulatory framework and governing authority, etc.

Risk is inherent and difficult to deal with, and this requires a proper management framework both of theoretical and practical meanings. Risk management is a formal and orderly process of systematically identifying, analyzing, and responding to risks throughout the life-cycle of a project to obtain the optimum degree of risk elimination, mitigation and control. Significant improvement to construction project management performance may be achieved from adopting the process of risk management.

The types of exposure to risk that an organization is faced with are wide-ranging and vary from one organization to another. These experiences could be the risk of business failure, the risk of project financial losses, the occurrences of major construction accidents, default of business associates and dispute and organization risks. It is necessary to understand and identify the risks as early as possible, so that appropriate strategy can be implemented to retain particular risks or to transfer them to minimize any likely negative aspect they may have.

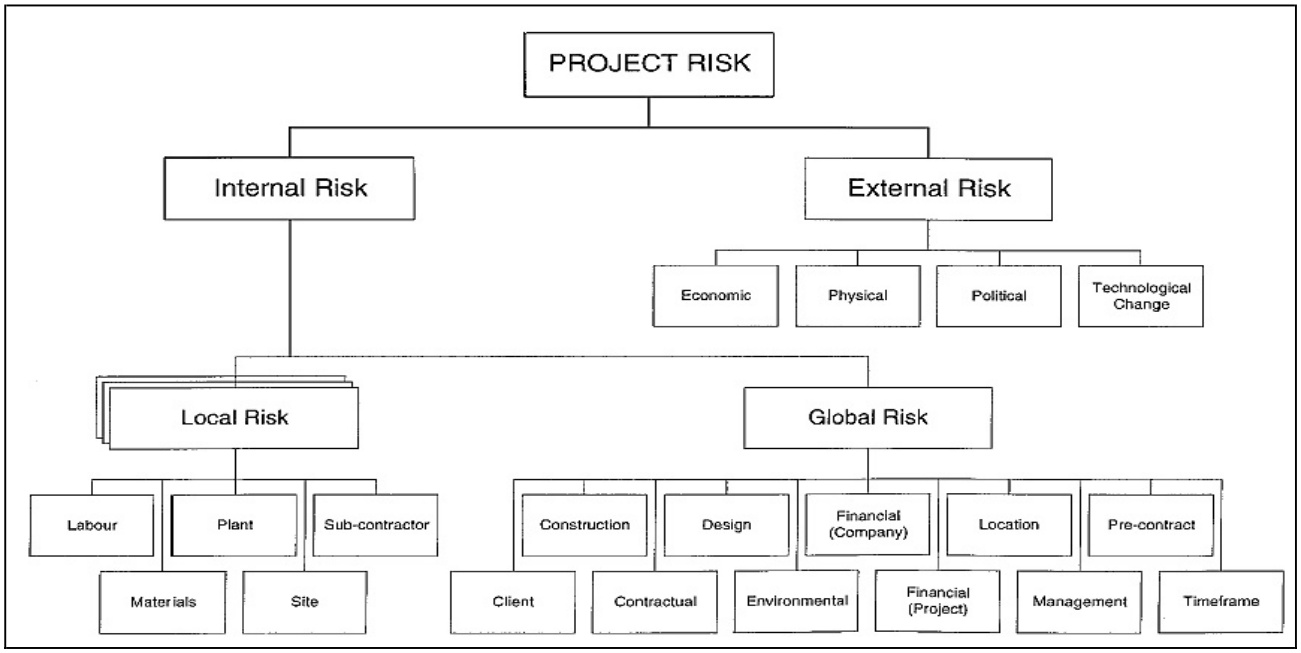


Figure 2.1 Hierarchical risks involved in a project (Source: A.Deviprasadh, 2007)

The risk management process begins with the initial identification of the relevant and potential risks associated with the construction project. It is of considerable importance since the process of risk analysis and response management may only be performed on identified potential risks. Risk analysis and evaluation is the intermediate process between risk identification and management. It incorporates uncertainty in a quantitative and qualitative manner to evaluate the potential impact of risk. The evaluation should generally concentrate on risks with high probabilities, high financial consequences or combinations thereof which yield a substantial financial impact. Once the risks of a project have been identified and analyzed, a suitable method of treating risk must be adopted. Within a framework of risk management, contractors also should decide how to handle or treat each risk and formulate suitable risk treatment strategies or mitigation measures. These mitigation measures are generally based on the nature and potential consequences of the risk. The main objective is to remove as much as possible the potential impact and to increase the level of control of risk. The control of one mitigation measure on one risk, the more effective the measure is. The

process of risk management does not aim to remove completely all risks from a project. Its objective is to develop an organized framework to assist decision makers to manage the risks, especially the critical ones, effectively and efficiently.

2.2.1 Risk and Uncertainty in construction projects

As Pouliquen (1970) states, risk analysis is a method for dealing with uncertainty. However, risk and uncertainty are not synonymous. Frame (2003) explains the difference is that when making decisions under conditions of risk, we know or can estimate the probability distribution of this risk event, whereas under conditions of uncertainty, we are unable to estimate the probability distribution. So Frame distinguishes risk and uncertainty according to information availability.

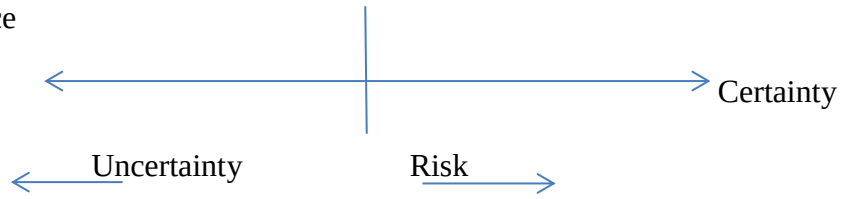


Figure 2.2, Risk, uncertainty and information availability for risk events (Source: Frame, 2003)

Raftery (1994) points out that risk and uncertainty characterize situations where the actual outcome for a particular event or activity is likely to deviate from the estimate or forecast value. As well, risks exist in projects because of their uniqueness and temporary nature and can impact on the project contractor and sub-contractors, stakeholders and project owner in a variety of ways. Leu et al. (2001) point out that during project implementation, many uncertain variables dynamically affect the project duration and the costs can thus change accordingly.

A risk has a cause and, if it occurs, a consequence. Risk also defined as the exposure to loss/gain or the probability of occurrence of loss/gain multiplied by its respective magnitude. The Project Management Institute (1996) introduced a simple definition for risk as a discrete occurrence that may affect the project for better or worse.

Interpretation of what a risk constituents:

Risk = Hazard x Exposure

Hazard=*"the way in which a thing or a situation can cause harm"*

Exposure=, *the extent to which the likely recipient of the harm can be influenced by the hazard".*

Uncertainty= is a situation in which a number of possibilities exist and which of them has occurred, or will occur, is unknown.

2.2.2The Nature of Risk

The nature and extent of commonly foreseen risks may change considerably with time. Although risk is fairly well documented in the literature, the terminology is not consistently applied across construction, project management, engineering, health and safety, environment, business and other industries (Del Cano and de la Cruz, 2002). Risk can be classified as voluntary or involuntary, depending on whether or not the events leading to the risk are under the control of the persons at risk or not (del Cano and de la Cruz, 2002). In the theoretical sense, (Enshassi & Mayer, 2001). view risk not as an inherent quality of the physical world but as a representation of the interaction between physical and psychosocial characteristics with the assessment of risk involving judgments about what is valued.

Kumamoto and Henley (1996) identified five attributes of risk. These are:

I. likelihood-the chance of occurrence of risk

ii. Outcome-to see consequence of risk

iii. Significance-the importance of risk is considered in terms of its severity

iv. Causal scenario-the aim is to consider various scenarios as options.

V. Population- risks raised in different residents(places) in identifying its severity.

2.2.3. Typical Risks on a Construction Project

A strict set of codes, laws, and regulations must be followed during the construction process to best avoid these risks. Unfortunately, there is no way to completely avoid risks as there are bound to be unknown factors that arise over the course of a project. One of the best ways to manage risks is to know the various types and how you can manage them. If you can identify and categorize risks before you start a project, you can optimize your risk management and avoid any possible losses.

Risks can be viewed as business, technical, or operational. A technical risk is the inability to build the product that will satisfy requirements. An operational risk is the inability of the customer to work with core team members. Risks are either acceptable or unacceptable. An acceptable risk is one that negatively affects a task on the non-critical path. An unacceptable risk is one that negatively affects the critical path. Risks are either short or long term. A short-term risk has an immediate impact, such as changing the requirements for a deliverable. A long-term risk has an impact sometime in the distant future, such as releasing a product without adequate testing. (Flanagan & Norman, 1993).

Table 2.1 Types of Construction Project Risk factors

Types of Construction Project Risk factors	
Physical	✓ Occurrence of accidents because of poor safety procedures ✓ Supplies of defective materials ✓ Varied labor and equipment productivity
Environmental	✓ Acts of God ✓ Difficulty to access the site (very far, settlements) ✓ Adverse weather conditions
Design	✓ Defective design (incorrect) ✓ Not coordinated design (structural, mechanical, electrical, etc.) ✓ Inaccurate quantities ✓ Lack of consistency between bill of quantities, drawings and specifications ✓ Rush design ✓ Awarding the design to unqualified designer
Logistics	✓ Unavailable labor, materials and equipment ✓ Undefined scope of working ✓ High competition in bids ✓ Inaccurate project program ✓ Poor communications between the home and field offices (contractor side)
Financial	✓ Inflation/Escalation ✓ Delayed payment on contract ✓ Financial failure of the contractor ✓ Unmanaged cash flow ✓ Exchange rate fluctuation ✓ Monopolizing of materials due to closure and other unexpected political conditions

Legal	✓ Difficulty to get permits ✓ Ambiguity of work legislations ✓ Legal disputes during the construction phase among the parties of the contract ✓ Delayed disputes resolutions ✓ No specialized arbitrators to help settle fast
Construction	✓ Rush bidding ✓ Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications ✓ Undocumented change orders ✓ Lower work quality in presence of time constraints ✓ Design changes ✓ Actual quantities differ from the contract quantities
Political	✓ Working at hot (dangerous) areas ✓ New governmental acts or legislations ✓ Unstable security circumstances (Invasions) ✓ Closure
Management	✓ Ambiguous planning due to project complexity ✓ Resource management ✓ Changes in management ways ✓ Information unavailability (include uncertainty) ✓ Poor communication between involved parties

2.2.4 Classifications of Risks in construction projects

Classification of risk is an important step in the risk management process, as it attempts to structure the various risks affecting a construction project. Project risks can be categorized in a number of ways according to the level of detail or a selected viewpoint (Smith et al., 2006). In order to manage risks effectively, many approaches have been suggested in the literature for classifying risks.

The PMI(Project Management Institute) (2000) classify risks as internal or external. Internal risks are those that arise within the scope and control of the project team. Most internal risks can be referenced to a specific project document such as design document, technical specifications, and cost estimate or a schedule. Internal risks usually refer to items that are inherently variable. External risks are items that are generally imposed on the project from establishments beyond the limits of the project. Interactions with regulators are typical external risks. Funding constraints and restrictions are other common external risks. External risks tend to refer to items that are inherently unpredictable but generally foreseeable (Caltrans, 2007).

Hilson (2002) argues that the common usage of the word ‘risk’ only centers on the negative outcomes. Ward and Chapman (2003) argue that risk is often associated with adversity, things that may go wrong, and threats to projects.

The risks for infrastructure projects, according to Yoyjie (2001) cited in Getachew (2009) have a wide range of sources and can be classified into the following broad categories:

Technical, quality or performance risk such as employment of inexperienced designers, changes to the technology used or to industry standards during the project.

Organizational risks such as cost, time and scope objectives that are internally inconsistent, lack of prioritization of projects, inadequacy or interruption of funding, and resource conflicts with other projects in the organization.

External risks such as shifting legal or regulatory environment including institutional changes, poor geological conditions and weather, force majeure risks such as earthquake, floods and other natural catastrophic events.

Project management risks such as poor allocation of time and resources, inadequate quality of the project plan, poor use of project management disciplines.

In the previous sections the introduction and classifications of risk were discussed, it was clear that seeing risk only as an event-type phenomenon is not sufficient, but the ambiguity and unpredictability related to the future conditions must also be considered. Many sources describe the risks resulting from ambiguity, variability and lack of data.

Ward and Chapman (2003) have identified five different categories of risks: Variability associated with estimates; when different estimates are produced on the same thing.

Risk about the basis of estimates; difficult to obtain the most accurate estimate. Risk about design and logistics; like Defective design (incorrect), Not coordinated design (structural, mechanical, electrical, etc.), Inaccurate quantities, Lack of consistency between bill of quantities, drawings and specifications, Rush design, Awarding the design to unqualified designer, Unavailable labor, materials and equipment, Undefined scope of working, High competition in bids, Inaccurate project program, Poor communications between the home and field offices. Risk about objectives and priorities; undefined objectives. Risk about fundamental relationships between project parties (stakeholders).The last one Risk about responsibilities, capabilities and proper mechanisms. From

their list of five risk areas, fifth is the most interesting. Here authors have recognized that difficulty to identify responsibilities, capabilities and proper mechanisms for coordination and control is "a pervasive source of Risk". They add that these relationships may or may not include formal contracts. , also pointed out that the stakeholders relationship management is among the challenges faced by developing countries construction industry, due to their being many in number in these countries.

2.2.5. Dynamic and Static Risks

Dynamic risk is concerned with making opportunities; for instance it might concern developing a new and innovative product. Dynamic risk means that there will be potential gains as well as losses. Dynamic risk is risking the loss of something certain for gain of something uncertain (Flanagan & Norman, 1993) and (NAO, 2001).

Static risk related only to potential losses where people are concerned with minimizing losses by risk aversion (Flanagan & Norman, 1993). The unsystematic and arbitrary management of risks can endanger the success of the project since most risks are very dynamic throughout the project lifetime (Baloi & Price, 2003).

2.3. Construction risk management planning -Conceptual Framework

This model placed risk management in the context of project decision making while considering the over-lapping contexts of behavioral responses, organization structure, and technology. The objectives of project and construction risk management should be clearly established within the context of project decision-making, and will be governed largely by the risk attitude of the project proponent. In discussing human judgments in decision making, proposes a sociological and organizational context for risk analysis. The construction risk management conceptual model

provides an effective systematic framework for quantitatively identifying, analyzing, and responding to risk in construction projects. With this model emphasis is placed on how to identify and manage risks before, rather than after, they materialize into losses or claims (Enshassi & Mayer, 2001).

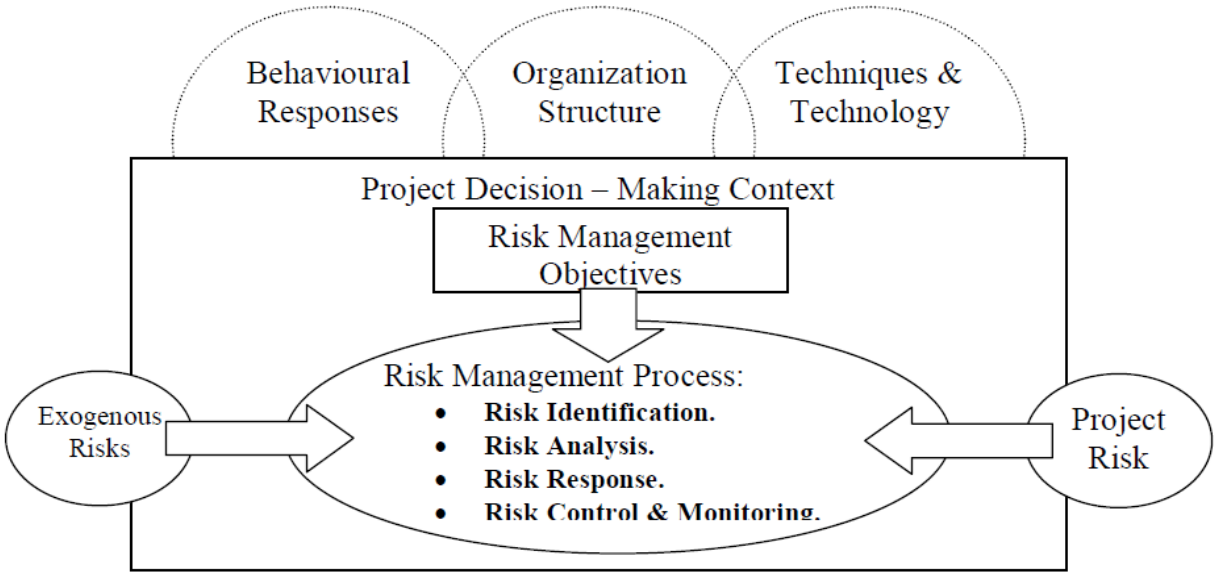


Figure2.3. Conceptual Model of Construction Risk Management, (Enshassi & Mayer, 2001)

2.3.1. Construction project risk management process

A number of variations of risk management process have been proposed. According to the Project Management Body of Knowledge (PMBOK, 2000), risk management is seen as the processes concerned with identifying, analyzing and responding to uncertainty throughout the project's lifecycle. It includes maximizing the results of positive events and minimizing the consequences of adverse events.

Shehu and Sommerville (2006) defined Risk management as a process of controlling the level of risk and to mitigate its effects. (Nummedal et al., 1996) cited in Getachew (2009), defined risk

management as a systematic approach for identifying, evaluating and responding to risks encountered in a project. Kerzner (2003) defined same as the act or practice of identifying, analyzing, and evaluating risk. Angelo and Rubin (2001) see risk management as an important part of any project management that limits delays, budget overruns, and claims between parties.

Risk management measures the potential changes in value that will be experienced in a portfolio as a result of differences in the environment between now and some future point in time (Dembo & Freeman, 1998).Al-Bahar cited in (Ahmed et al, 1999) defined the risk management as a formal orderly process for systematically identifying, analyzing, and responding to risk events throughout the life of a project to obtain the optimum or acceptable degree of risk elimination or control

Risk management is the process which consists of identification, assessment, response, control as shown below.

Figure 2.4 Risk Management Process (IJITEE,2013)

The overall objective of the risk management process is to maximize the opportunities and minimize the consequences of risk events (Shehu and Sommerville, 2006). Dealing with risk involves planning for risk, assessing risk issues, developing risk handling strategies, and monitoring risks to determine how they have changed.

2.3.2. Risk Identification

This is the first stage in risk management and it entails capturing all the potential risks that could arise within the project. It is commonly acknowledged that of all the stages of risk management

process, risk identification stage has the largest impact on the accuracy of any risk assessment (Chapman, 1998). To facilitate risk identification, risks can also be broadly categorized as controllable and uncontrollable risks (Flanagan and Norman, 1993). Further, controllable risks are those risks which a decision maker undertakes voluntarily and whose outcome is, in part, within our direct control; and uncontrollable risks as those risks which we cannot influence (Chege & Rwelamila, 2000). Risk identification consists of determining which risks are likely to affect the project and documenting the characteristics of each. Risk identification is not a onetime event; it should be performed on a regular basis throughout the project (PMI, 1996). The identification of risks consists of a method used to generate risks, and guidance on what those risks should look like when written down (Isaac, 1995).

Risk identification should address both internal and external risks. Internal risks are things that the project team can influence, such as staff assignments and cost estimates. External risks are things beyond the control or influence of the project team, such as government actions. In project context, risk identification is also concerned with opportunities (positive outcomes) as well as threats (negative outcomes) (PMI, 1996). At this stage, a broad view should be taken to ascertain without any constraint the risks that are likely to impede the project in meeting its cost target. A failure to recognize the existence of one or more potential risks may result in a disaster or foregoing an opportunity for gain resulting from proper corrective action (Enshassi & Mayer, 2001).

When attempting to identify risk, it is rather like trying to map the world. Maps of the world tend to be centered on the location of the map maker. Much of the world is not visible from where you stand. Some territory which is familiar and obvious to you may not be obvious to everyone. Similarly, looking at a large project from the top, with multiple layers of planning, complex vertical and horizontal interactions, and sequencing problems, resembles looking into the world map

through a fog. Management's ability to influence the outcome is limited to what they can see. The great temptation is to focus upon what should happen, rather than what could happen. A clear view of the event is the first equipment, focusing on the sources of risk and effect of the event (Flanagan & Norman, 1993). While extensive catalogues of risk can be devised, these are always likely to be incomplete and therefore inadequate. This may lead to decision-makers failing to consider the full spectrum of potential risks for a project. Developing categories of risk is one way of typifying risks so that this danger can be minimized (Enshassi & Mayer, 2001).

Risk identification involves identifying, categorizing and recording potential risks, together with information on their cause(s) and possible effect(s), which might affect the project objectives (Shehu and Sommerville, 2006). It is aimed at determining potential risks, i.e. those that may affect the project significantly.

Ward and Chapman (1995) suggest that it is often said that the real risks in any project are the ones that the project team fails to identify. Jenkins (1998) explains that risk identification at the operational level is very effective and can help with on-the-spot improvements and day to- day management. Tasmania (2002) also suggests that before risks can be properly managed, they need to be identified. One useful way of doing this is defining categories under which risks might be identified: for example, in terms of risks external to the project and those that are internal. It is also desirable to identify risks based on the determined objectives, which are generally related to cost, time, and quality aspects.

The identification process will vary, depending on the nature of the project and the risk management skills of the team members, but most identification processes begin with an examination of issues and concerns created by the project development team. These issues and concerns can be derived from an assessment of the project description, work breakdown structure,

cost estimate, design and construction schedule, procurement plan, or general risk checklists. This is a practical way of addressing the large and diverse numbers of potential risks that often occur on highway design and construction projects. Risks are those events that team members determine would adversely affect the project (Caltrans, 2007).

The identification phase is stressed by many researchers (Chapman, C., 2002, Chapman, R.J., 2001, Turner, J.R., 1999). It is quite obvious that if we are unaware of the risks, it's difficult to manage them, though this view is limited to the event-type scope of risk management. Chapman (2001) pointed out that since the risk management process builds heavily on the primary identification phase, the success of later risk management phases is directly comparable to the quality of the first identification phase.

PMBOK (2000) stipulates that as many project stakeholders as possible should participate in the risk identification process. Participants in risk identification activities can include the following, where appropriate: project manager, project team members, risk management team (if assigned), subject matter experts both from the project and from outside the project team, customers, end users, other project managers, stakeholders, and risk management experts. While these personnel are often key participants for risk identification, all project personnel should be encouraged to identify risks.

Table 2.2 Risk identification techniques

Information gathering methods	✓ Workshops ✓ Brainstorming ✓ Interviews ✓ Questionnaires ✓ Benchmarking ✓ Consulting experts ✓ Past experience ✓ Delphi technique ✓ Risk breakdown structure ✓ Visit locations
Documentation	✓ Databases, historical data from similar projects ✓ Templates ✓ Checklists ✓ Study project documentation (plan, files etc.) ✓ Study specialist literature
Research	✓ Stakeholder analysis ✓ Research assumptions ✓ Research interfaces

2.3.3. Risk Analysis

Risk analysis, a component of the risk management process, deals with the causes and effects of events which cause harm. The aim behind such analysis is a precise and objective calculation of risk. To the extent that this is possible, it allows the decision making process to be more certain (Estate Management Manual, 2002). The essence of risk analysis is that it attempts to capture all feasible options and to analyze the various outcomes of any decision. For building projects, clients

are mainly interested in the most likely price, but projects do have cost over-runs and, too frequently, the 'what if' question is not asked (Flanagan & Norman, 1993).

Risk analysis involves assessing the identified risks. This first requires that the risks are quantified in terms of their effect on cost, time or revenue. They can be analyzed by measuring their effects on the economic parameters of the project or process. In terms of risk response, three general types of response can be identified (Estate Management Manual, 2002):

- ✓ Risk avoidance or reduction.
- ✓ Risk transfer.
- ✓ Risk retention.

The use of risk analysis gives an insight into what happens if the project does not proceed according to plan. When active minds are applied to the best available data in a structured and systematic way, there will be a clearer vision of the risks than would have been achieved by intuition alone (Flanagan & Norman, 1993).

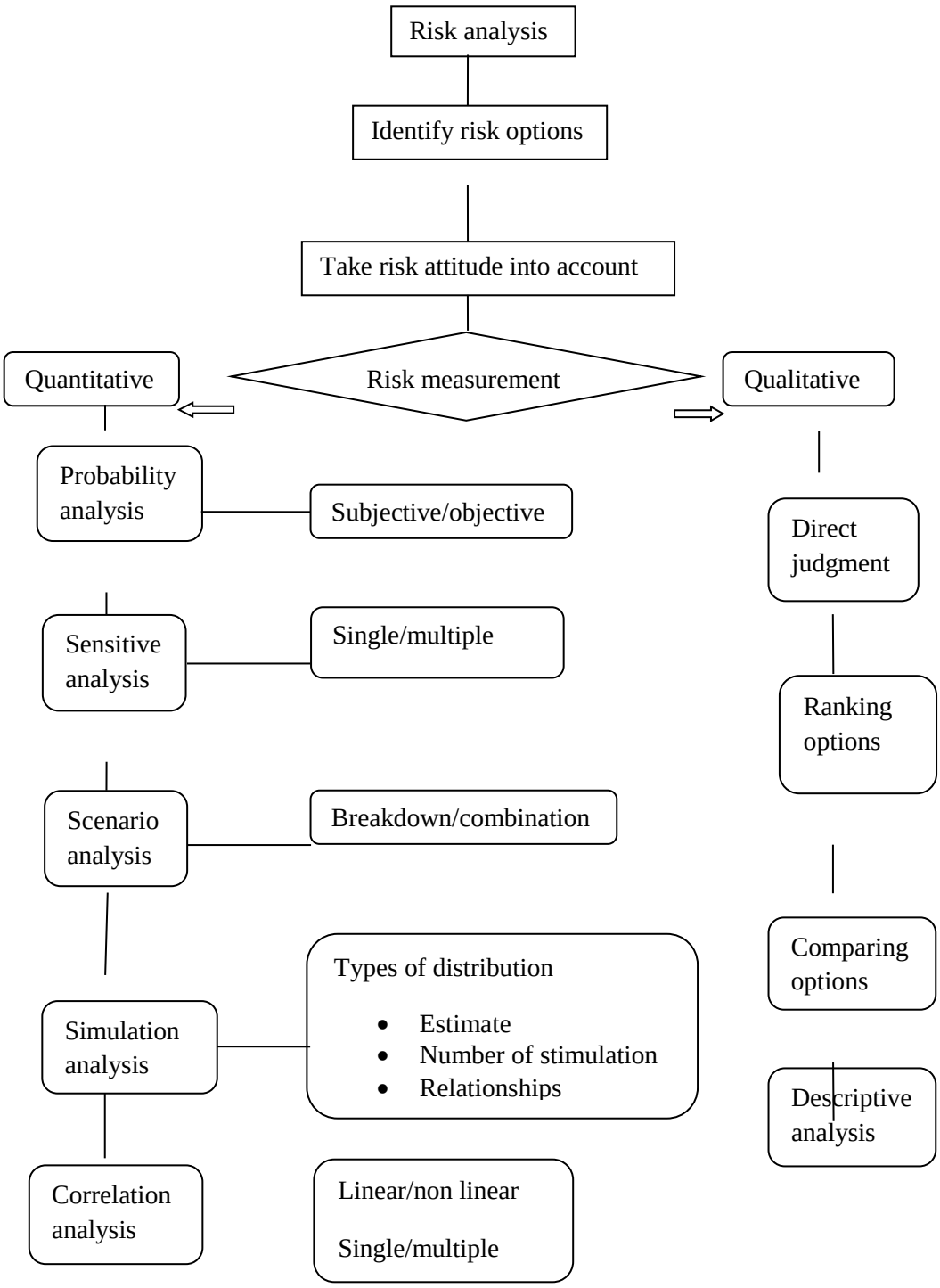


Figure 2.5 Risk Analysis Sequence (Flanagan & Norman, 1993)

The traditional approach to forecasting construction price or construction duration at the design stage of a project is to use the available data and produce a single point best estimate. The risk analysis approach explicitly recognizes uncertainty that surrounds the best estimate by generating a probability distribution based upon expert judgment. Therefore, the understanding about the effects of uncertainty upon the project will be improved. Risk analysis must not be viewed as a stand-alone activity; any strategies developed must not be seen as cast in stone commandants. Rather, these should be seen as a component of all decisions made continually to respond to project dynamics (Jaafari, 2001). Risk analysis involves evaluating risks and risk interactions to assess the range of possible project outcomes. It is complicated by a number of factors including, but not limited to (PMI, 1996):

Opportunities and threats can interact in unanticipated ways (e.g., schedule delays may force consideration of new strategy that reduces overall project duration).A single risk event can cause multiple effects, as when late delivery of a key material produces cost overruns, schedule delays, penalty payments, and a lower quality product. The mathematical techniques used can create a false impression of precision and reliability.

What is needed is an application of risk analysis to help project managers control cost that is relatively simple to apply, can be used throughout the life cycle of a construction project, accounts for the tendency of construction professionals to apply risk in linguistic terms, and apply their experience (Bender & Ayyub, 2001).

2.3.3.1 Methods of Risk Analysis

The analysis of risks can be *quantitative* or *qualitative* in nature depending on the amount of information available. Qualitative analysis focuses on identification together with assessment of risk, and quantitative analysis focuses on the evaluation of risk

Risk Analysis	
Qualitative	Quantitative
Direct judgment Ranking options Comparing options Descriptive analysis	Probability analysis Sensitivity analysis Scenario analysis Simulation analysis

Table 2.3 Various risk analysis techniques, adapted from (Ward and Chapman, 1997)

A. Qualitative Risk Analysis

Qualitative methods depend on the personal judgment and past experiences of the analyst and the results may vary from person to person. Lowe (2002) introduced a definition for the qualitative assessment of risk involves the identification of a hierarchy of risks, their scope, factors that cause them to occur and potential dependencies. The hierarchy is based on the probability of the event and the impact on the project. In qualitative risk analysis risk management acts as a means to registering the properties of each risk (Kuismanen et al, 2002). Qualitative risk analysis assesses the importance of the identified risks and develops prioritized lists of these risks for further analysis or direct mitigation. The management team assesses each identified risk for its probability of occurring and its impact on project objectives. Sometimes experts or functional units assess the risks in their respective fields and share these assessments with the team (Office of project management process improvement, 2003). Components of risk analysis were introduced by Kindinger and Darby (2000):

- ✓ List activities, tasks, or elements that make up the project.
- ✓ Identify applicable risk factors.

- ✓ Develop risk-ranking scale for each risk factor.
- ✓ Rank risk for each activity for each risk activity.
- ✓ Document the results and identify potential risk-reduction actions.

B. Quantitative Risk Analysis

Quantitative risk analysis is a way of numerically estimating the probability that a project will meet its cost and time objectives. Quantitative analysis is based on a simultaneous evaluation of the impact of all identified and quantified risks. The result is a probability distribution of the project's cost and completion date based on the risks in the project (Office of Project Management Process Improvement, 2003). The quantitative methods rely on probability distribution of risks and may give more objective results than the qualitative methods, if sufficient current data is available. On the other hand, qualitative methods depend on the personal judgment and past experiences of the analyst and the results may vary from person to person. Hence the quantitative methods are preferred by most analysts (Ahmed et al, 2001).

Quantitative risk analysis considers the range of possible values for key variables, and the probability with which they may occur. Simultaneous and random variation within these ranges leads to a combined probability that the project will be unacceptable (Asian Development Bank, 2002). Quantitative risk analysis involves statistical techniques that are most easily used with specialized software (Office of Project Management Process Improvement, 2003). Quantitative risk analysis is to assign probabilities or likelihood to the various factors and a value for the impact then identify severity for each factor (Abu Rizk, 2002). When thorough quantitative risk analysis is necessary it can take two alternative approaches (Kuismanen, 2001): Risks can be quantified as individual entities while looking at the big picture. This way can include the cumulative effects (to

certain accuracy) into each individual risk and thus make more accurate estimations of the net value of the risks.

Alternatively modeling the mathematical properties of the interrelations from the bottom up can be started and then calculate the net impact of each risk including the effects of interrelations.

Basic Steps of quantitative risk analysis

As discussed previously, the aim of risk analysis is to determine how likely an adverse event is to occur and the consequences if it does occur. When quantitative risk analysis is to be done, it is attempted to describe risk in numerical terms. To do this, it should go through a number of steps (Kelly, 2003):

1. Define the consequence; define the required numerical estimate of risk.
2. Construct a pathway; consider of all sequential events that must occur for the adverse event to occur.
3. Build a model - Collect data; consider each step on the pathway and the corresponding variables for those steps.
4. Estimate the risk; once the model has been constructed and the data collected the risk can be estimated. Included in this estimation will be an analysis of the effects of changing model variables to reflect potential risk management strategies.
5. Undertake a sensitivity and scenario analysis; undertaking a risk analysis requires more information than for sensitivity analysis.

2.3.4 Risk Monitoring and Control

An essential function of the construction project manager is the control of projects and hence the control of risks. Risk monitoring is required so as to respond to events that occur over the course of a project. Risk control can be achieved through the updating of risk management plans with new

information, identifying alternatives to unplanned risk events, and by mitigating unplanned risks (Del Cano and de la Cruz, 2002). Risk monitoring and control keeps track of the identified risks, residual risks, and new risks (Caltrans, 2007). It also monitors the execution of planned strategies on the identified risks and evaluates their effectiveness.

Risk monitoring and control continues for the life of the project. The list of project risks changes as the project matures, new risks develop, or anticipated risks disappear. Typically during project execution there should be regularly held risk meetings during which all or a part of the Risk Register is reviewed for the effectiveness of their handling and new risks are discussed and assigned owners. Periodic project risk reviews repeat the process of identification, Register, analysis, and response planning. The project manager ensures that project risk is an agenda item at all Project developing team meetings. Risk ratings and prioritization commonly change during the project lifecycle. If an unanticipated risk emerges, or a risk's impact is greater than expected, the planned response may not be adequate. The project manager and the Project developing team must perform additional response planning to control the risk.

According to Caltrans (2007), Risk control involves: Choosing alternative response strategies; implementing a contingency plan; Taking corrective actions; and Re-planning the project, as applicable.

The individual or a group assigned to each risk (the risk owner) reports periodically to the project manager and the risk team leader on the status of the risk and the effectiveness of the response plan. The risk owner also reports on any unanticipated effects, and any mid-course correction that the Project developing team must consider in order to mitigate the risk.

2.3.5. Risk Response Planning and Mitigation

The outcome of risk assessment is a quantified risk register and possible impact of risk factors on main project objectives (cost, schedule and performance). Some risk assessment exercises are considered complete at this stage. The risk team is now aware of the major risk factors and they embark on the execution of project with that knowledge. It is strongly recommended however that the risk analysis process be a continuous process during the project life cycle (Chapman, 2002). As a minimum, a formal risk mitigation effort should be administered and implemented so as to make the earlier effort worthwhile.

PMI (1996) suggested three ways of responding to risk in projects, they are as follows:

Avoidance: eliminating a specific threat, usually by eliminating the cause. The project management team can never eliminate all risks, but specific risk events can often be eliminated.

Mitigation: reducing the expected monetary value at risk events by reducing the probability of occurrence (e.g., using new technology), reducing the risk event value (e.g., buying insurance), or both. Acceptance: accepting the consequences. Acceptance can be active by developing a contingency plan to execute should the risk event occur or passive by accepting a lower profit if some activities overrun.

Abu Rizk (2003) suggested some actions to be taken in response to residual risks. Actions can include: Reduce uncertainty by obtaining more information, this leads to re-evaluation of the likelihood and impact. Eliminate or avoid the risk factor through means such as a partial or complete redesign, a different strategy or method etc.Transfer the risk element by contracting out affect work. Insure against the occurrence of the factor. Abort the project if the risk is intolerable and no other means can be undertaken to mitigate its damages.

Ahmed et al (2001), Akintoyne and MacLeod (1997), Enshassi and Mayer (2001), and Education and Learning Whales (2001) argued that there are four distinct ways of responding to risks in a construction project, namely, risk avoidance, risk reduction, risk retention and risk transfer. Those ways are discussed in below briefly.

Risk Avoidance

Risk avoidance is sometimes referred to as risk elimination. Risk avoidance in construction is not generally recognized to be impractical as it may lead to projects not going ahead, a contractor not placing a bid or the owner not proceeding with project funding are two examples of totally eliminating the risks. There are a number of ways through which risks can be avoided, e.g. tendering a very high bid; placing conditions on the bid; pre-contract negotiations as to which party takes certain risks; and not biding on the high risk portion of the contract (Flanagan & Norman, 1993).

Risk Transfer

This is essentially trying to transfer the risk to another party. For a construction project, an insurance premium would not relieve all risks, although it gives some benefits as a potential loss is covered by fixed costs (Tummala & Burchett, 1999)

Risk transfer can take two basic forms: The property or activity responsible for the risk may be transferred, i.e. hire a subcontractor to work on a hazardous process; the property or activity may be retained, but the financial risk transferred, i.e. by methods such as insurance and surety.

Risk Retention

This is the method of reducing controlling risks by internal management (Zhi, 1995); handling risks by the company who is undertaking the project where risk avoidance is impossible, possible financial loss is small, probability of occurrence is negligible and transfer is uneconomic

(Akintoyne & MacLeod, 1997). The risks, foreseen or unforeseen, are controlled and financed by the company or contractor. There are two retention methods, *active* and *passive*;

A. Active retention (sometimes referred to as self-insurance) is a deliberate management strategy after a conscious evaluation of the possible losses and costs of alternative ways of handling risks.

B. Passive retention (sometimes called non-insurance), however, occurs through negligence, ignorance or absence of decision, e.g. a risk has not been identified and handling the consequences of that risk must be borne by the contractor performing the work.

Risk Reduction

This is a general term for reducing probability and/or consequences of an adverse risk event. In the extreme case, this can lead to eliminate entirely, as seen in "risk avoidance". However, in reduction, it is not sufficient to consider only the resultant expected value, because, if potential impact is above certain level, the risk remains unacceptable. In this case, one of the other approaches will have to be adopted (Piney, 2002).

2.3.6. Causes of Risk as Threats

There exists no comprehensive study explaining the causes of risks among construction companies, moreover research covering the subject matter has tended to identify the symptoms rather than causes, a number of authors have attempted in their studies to ascertain the causes of threats in the construction industry, Kangari (cited in Rwelamila & Lobelo, 1997) ascribed the high threats to:

- A highly fragmented industry.
- Industry highly sensitive to economic cycles.
- Fierce competition as result of an over-capacitated market.

- Relative ease of entry.
- Management problems.
- Trading including:
    - Competitive quoting.
    - Outsize projects.
    - High gearing.
    - Resistance to change.
- Accounting, where inconsistencies occur in the financial data generated for management.
- Increase in project size.
- Unfamiliarity with new geographic area.
- Moving into new type of construction.
- Change in key personnel.
- Technological risks.

2.3.7 Causes of risk in construction projects

There exists no comprehensive study explaining the causes of risks among construction companies, moreover research covering the subject matter has tended to identify the symptoms rather than causes, a number of authors have attempted in their studies to find out the causes of threats in the construction industry, and Kangari (cited in Rwelamila & Lobelo, 1997) assign the high threats to:A highly fragmented industry, Industry highly sensitive to economic cycles, Fierce competition as result of an over-capacitated market, Relative ease of entry, Management problems. Trading including: Competitive quoting, Outsize projects, High gearing, Resistance to change ,Accounting, where inconsistencies occur in the financial data generated for management, Increase in project size, Unfamiliarity with new geographic area, Moving into new type of construction and Change in key personnel.

2.4 Past research work on risk management

The subject of risk management has been influential ever since colonies of people have evolved. In Covello and Mumpower's (1985) article, and according to Grier (1981), the first signs of risk management go back as far as 3200 BC in the Tigris-Euphrates valley with a group of people called the Asipu. One of their functions was to act as risk consultants. Their procedure would be to identify the important dimensions of the problem, propose alternative actions, and collect data on the likely outcomes. Their data sources, though, were signs from the gods. Each alternative option would be interpreted from the gods, and either a plus or a minus sign would result, whether the idea was a favorable one, or not. Then, the most favorable action would be selected from the pool of positive responses and reported to the client.

Bahiru Bewket Mitikie (2017) identified the impact level of risk on project objectives. By developing the construction risk management practice, it enhances achievement of project objectives, there by contributing to effective implementation of the project performance. The main objective of the research was to assess the impact of risk in project time, cost and quality. From these identified risks factors those have very high risk level on project costs are equipment/material failure, labour poor productivity and equipment scarcity. Lack of training, communication is high risk level in project cost. The quality of the project affected by labour poor productivity is very high. The others like equipment/material failure, managerial inadequacy, and lack of training, lack of communication and departures of qualified staff are high risk level in term of quality. Generally very high risks are rating based on the analysis in project performance are equipment/material failure, the labour poor productivity and equipment and material non-availability, their risk level was greater than 50%. The second specific objective was to identify whether water work construction project risks are managed with formal Risk management system.

Shen L Y (1997) identified the most serious project delay risks and the effective actions for managing these risks. Practitioners' risk management actions and their effectiveness have been investigated through a questionnaire survey. It revealed that methods where practitioners' experience and subjective judgement are used are the most effective and important risk management action, and that methods using quantitative analytical techniques have been rarely used due to limited understanding and experience. The findings also suggest a need to promote the application and awareness of various analytical techniques for risk management in a proper context in the Hong Kong construction industry.

Li Bing and Robert L. K. Tiong (1999) based on their study categorised the risk factors and their mitigating measures, the most effective risk mitigating measures were categorized into eight groups. Those are partner selection, agreement, employment, control, subcontracting, engineering contract, good relationship, and renegotiation. They proposed a risk management model incorporating measures. Three cases of international construction JVs were analyzed from the perspectives of the execution of these measures.

Li Bing et al (1999) identified the risk factors associated with international construction joint ventures (JVs) from and ‘‘integrated’’ perspective. The risk factors were grouped into three main groups: (1) Internal; (2) Project- specific; and (3) External. The study examined the most effective mitigating measures adopted by construction professionals in managing these risks for their construction projects in East Asia. Based on an international survey of contractors, it was found that the most critical risk factors exist in the financial aspects of JVs, government policies, economic conditions, and project relationship. When entering a foreign construction market in the formof a JV, a foreign construction company could reduce its risks if it would carefully select its local partner, ensure that a good JV agreement is drafted, choose the right staff and

subcontractors, establish good project relationships, and secure a fair construction contract with its client.

Patel Ankit Mahendra, Jayeshkumar R. Pitroda, J. J. Bhavsar(2015) Risk management technique rarely used by the participants in developing countries construction projects. The participants used to handle the risks with an informal approach. This technique is not employed because of less knowledge and awareness among the construction industry. The risk management technique should be applied into any construction project at the initial stage of the project to get maximum benefit of the technique. Hence, there is thriving need to have a well-documented procedure which should be a one stop solution to all hazards that are likely to occur during project life cycle. There should be more wholesome approach towards risk management instead of the present sporadic approach towards the risks.

Shou Qing Wang (2000) based on their survey on risk management of build- operate-transfer (BOT) projects in developing countries, with emphasis on infrastructure projects in China, discussed specifically the criticality of the political and force majeure risks. Based on the survey, critical risks, in descending order of criticality, were identified: Chinese Parties' reliability and creditworthiness, change in law, force majeure, delay in approval, expropriation, and corruption. The measures for mitigating each of these risks are also discussed.

Hastak and Shaked (2000) in their study classified all risks specific to whole construction scenario into three broad levels, i.e. country, market and project levels. Macroeconomic stability is partly linked to the stance of fiscal and monetary policy, and to a country's vulnerability to economic shocks. Construction market level risks, for a foreign firm, include technological advantage over local competitors, availability of construction resources, complexity of regulatory processes, and attitude of local and foreign governments towards the construction industry while project level risks

are specific to construction sites and include logistic constraints, improper design, site safety, improper quality control and environmental protection, etc.

Prashant Kapila1 and Chris Hendrickson (2001) they identified the financial risk factors associated with international construction ventures from an integrated perspective. They examined the most effective mitigation measures adopted by construction professionals in managing these risks for their construction projects and suggests other means of risk aversion.

Ming T Wang et.al (2003) conducted multiple-case studies using a systematic analytical procedure to identify risks in highway projects in Taiwan, to recognize risk allocation by contract clauses, and to analyze the influence of risk allocation on the contractor's risk handling strategies. The results show that the owner allocates risks by stipulating specific contract clauses into five kinds of risk allocation conditions. If a risk is more controllable by the contractor, the owner has a greater tendency to allocate the risk to the contractor. Risk allocation determines which kinds of risks the contractor would take and influences the contractor's risk handling decisions. The analysis furthermore indicated that, if the probability of a certain risk event condition is uncontrollable, then with the increasing possibility of taking the risk, the contractor's tendency of risk handling changes from actively transferring the risk to passively retaining the risk. In contrast, if a risk is controllable and certainly allocated to the contractor, the contractor tends to take the initiative to reduce the impact caused by the risk event rather than retain the risk.

2.5. Summary

Definitions and concepts applicable in the field of risk management in general and classification of some risks and risk factors obtaining in building construction projects were outlined in this chapter

Risk management has been defined as “an ongoing process of identifying risks ,developing responses through risk definitions ,risk probability assessment and risk reduction strategy formulation ;and finally risk control through continuous monitoring of the project “

Key terminology used in risk management such as risk identification, risk probability analysis , risk monitoring and control have been defined. Techniques used in risk identification and probability analysis have also been discussed .These includes asking contractors, learning from past ,similar projects, qualitative analysis and quantitative analysis.

Four main ways of reducing risks were also outlined in this chapter and these included transference, avoidance or elimination, mitigation and acceptance.

In chapter three that follows, research methods, general terminologies and those that may be applicable in the field of risk management are outlined.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 General approach

This research methodology includes research strategy, research design, target population and sample size, the instrument used to collect the data, analysis and interpretation will be described.

The methodology adopted in this project is given below:

1. Study of literature related to Risk Analysis and Risk Management capabilities
2. Preparation of Questionnaire.
3. Site visit to major construction project sites.
4. Questionnaire survey and personnel interviews with in-charges and managers and collection of data from site.
5. Analyzing the Questionnaire
6. Qualitative analysis of data obtained from site and to identify the root cause.

3.2 Research Strategy

Under these research strategies **quantitative** and **qualitative** methods are used.

Quantitative: - approaches seek to gather factual data and to study relationships between facts and how such facts and relationships accord with theories and the findings of any research executed previously. We will focus on this approach. **Questionnaires with interviews** for selected contracting firms/companies.

Qualitative: - approaches seek to gain insights and to understand people's perception of "the world "whether as individuals or groups. Qualitative research is "subjective" in nature, emphasizing meanings, experiences and so on.

- ✓ Interviews for contractors.
- ✓ Observations on currently on going on building projects.

3.3 Research design

The term "research design" refers to the plan or organization of scientific investigation, designing a research study involves the development of a plan that guide the collection and analyses of data (Polit & Hunger, 1999). Burns & Grove (1997) defined the term design as "some consider research design to be the entire strategy for the study, from identifying the problem to find the plans for data collection. Other limit design to clearly define structural framework within which the study is implemented". The framework that the researcher creates is the design (Wood & Haber, 1998). Much research in the social sciences and management spheres involves asking and obtaining answers to questions through conducting surveys of people by questionnaires, interviews and case studies (Fellows & Liu, 1997).

In this research a closed-ended questionnaire with interview is used to collect data from respondents. In structured interview, questions are presented in the same order and with the same language to all interviewees. The interviewers have full control on the questionnaire throughout the entire process of the interview (Naoum, 1998).

In structured interview, the interviewer administers a questionnaire, perhaps by asking the questions and recording the responses, with little scope for probing those responses by asking supplementary questions to obtain more details and to pursue new and interesting aspects (Fellows & Liu, 1997). Naoum (1998) summarizes the main advantages of structured interview as follows:

- The answers can be more accurate.
- The response rate is relatively high (approximately 60-70 percent), especially if interviewees are contacted directly.
- The answers can be explored with finding out "Why" the particular answers are given.

3.4 Research population

A population consists of the totality of the observation with which we are concerned (Walpole & Myers, 1998). In this research, the population is the total numbers of building contractors (190 building construction companies) of above grade three who have valid registration(contractors catalogue ,2015). are addressed by the study.

3.5 Sample Size

Sampling defines the process of making the selections; sample defines the selected items (Burns & Grove, 1987). Wood and Haber (1997) defined the sampling as the process of selecting representative units of a population for the study in a research investigation. Scientists derive knowledge from samples; many problems in scientific research cannot be solved without employing sampling procedures (Wood & Haber, 1997).One of the most frequent questions asked "what size sample I use?" historically, the responses to this question at least 30 subjects. However, 35 questionnaires are distributed to contracting firms.

3.6 Questionnaire Structure and design

The structured interview questionnaire is shown in Appendix A. The questionnaire was tested with a pilot survey for clarity, ease of use, and value of the information that could be gathered. The questionnaire survey is divided into two parts. The first part consists of general information like type of company, experience, value of their project e.t.c. and the second part consists of the construction risk factors for evaluation.

The survey questionnaire is designed to review the cross-sectional behavioral pattern of construction risks construction industry. The questionnaire was prepared for the pilot survey was formulated by seeing the relevant literatures in the area of construction risk. The

interviewer was free to ask additional questions that focused on issues arising during the course of the interview. The freedom to follow the interviewee, to ask for clarifications, and to focus on specific projects, risk practices and knowledge, made the interviews insightful.

Risk factors for this study are classified into six categories, namely:

1. Financial risk factors
2. Legal risk factors
3. Management risk factors
4. Design risk factors
5. Construction risk factors
6. Physical risk factors

3.7 Method of data collection

The methods in collecting data was both qualitative and quantitative from both primary and secondary sources. Primary data was collected through interviews, questionnaires and observation. Secondary data was obtained by thoroughly studying and investigating documents obtained from organizations and experienced people. Those secondary data could be:

- ✓ Written documents
- ✓ Reports related to risk management
- ✓ Internet

Data collection by the mentioned techniques analyzed followed by conclusion and recommendation.

CHAPTER4: RESULTS AND DISCUSSION

4.1. Introduction

The aim of this study is to determine the risk factors in construction industry, allocation of these factors, methods used to deal with risks and the techniques adopted in analyzing these risks. Mainly, the severity of risk factors, allocation of each, methods of dealing with risks and techniques of analysis.

To fulfill this objective of the research, an interview was conducted. The firms to which the interviews are to be interviewed are identified from a list of building contractors those registered in this year and those of grade three and above. And samples were selected using simple random sampling method.

4.2. Risk factors

As mentioned in chapter 3, the questionnaire included 6 risk factor groups: physical group, design group, financial group, legal group, construction group, and management group. The factors of each group will be demonstrated in the terms of severity and allocation according to the participants answers.

4.2.1. Physical group

Severity

Results verified that the supply of defect materials is the most important risk in the physical group (Table4.1), occurrence of accidents was the second from importance and the third was the variation in labor and equipment productivity. These results indicate the concerns of contractors about suitability of materials and safety measures.

Table 4.1. Physical group risks

No	Physical Group Risks	SEVERITY
1	Supplies of defective materials	high
2	Occurrence of accidents because of poor safety procedures	medium
3	Varied labor and equipment productivity	low

Allocation

The criterion for a risk to appropriated to a particular category (owner, contractor, shared, insurance or ignored), was that it should get at least (60%) response rate to achieve the majority of the rates. Those that failed to get such response rate in favor of any category were listed as undecided. As shown below, (39%) of contractors tried to shift the consequences of accidents to other parties such as insurance, (42%) of contractors appeared to be ready to bear these consequences and (19%) of them seemed to share these consequences with owners.

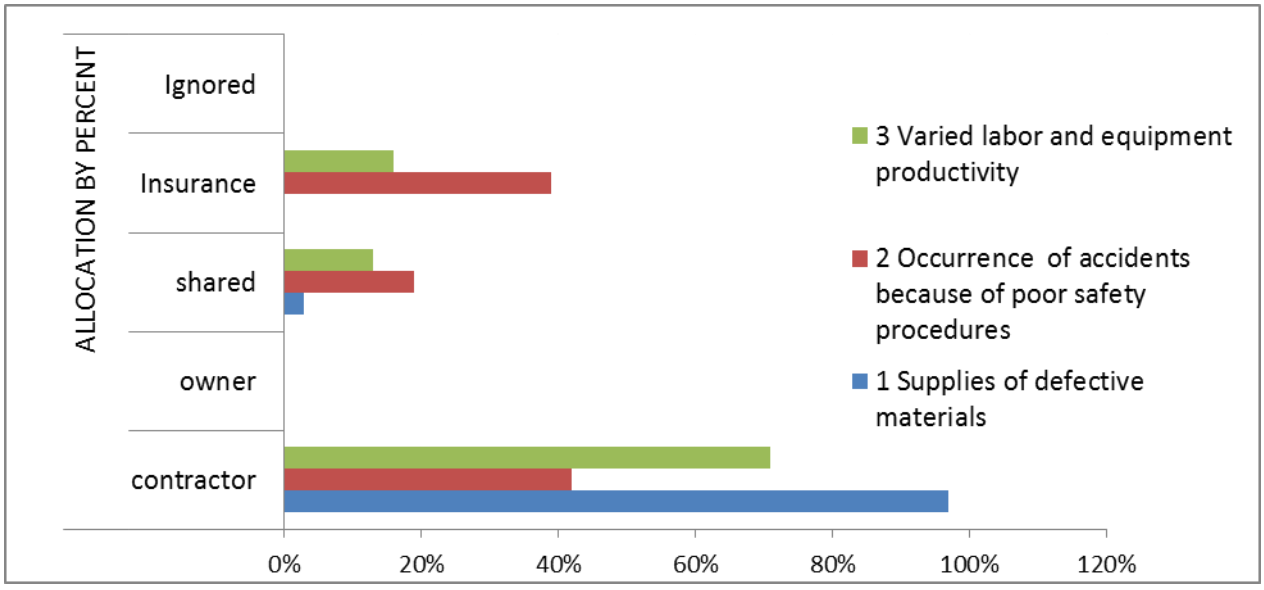


Figure 4.1. Physical group risks allocation, contractors' perspective

In fact contractors are better able to control such risks by supervising the application of safety precautions inside the construction sites. Moreover, the existence of insurance premiums for accidents and injuries can mitigate some of these risk consequences. Contractors should consciously pay more effort to mitigate the accidents costs and other consequences by applying effective training and increasing awareness of safety precautions. The majority of contractors (97%) accepted the risks of supplying defect materials and variation in productivity (71%). In fact, not only did contractors designate them as their responsibilities, but most researchers also support this position.

4.2.2 Design group

Severity

Design group factors included one of the most important surveyed risks. As illustrated in Table (4.3), defective design is the most important factors. These results also show that contractors suffer from insufficient or incorrect design information.

Table 4.3 Design group risks

No	Design Group Risks	SEVERITY
1	Defective design (incorrect)	high
2	Not coordinated design (structural, mechanical, electrical, etc.)	high
3	Lack of consistency between bill of quantities, drawings and specifications	medium
4	Inaccurate quantities	medium
5	Rush design	medium

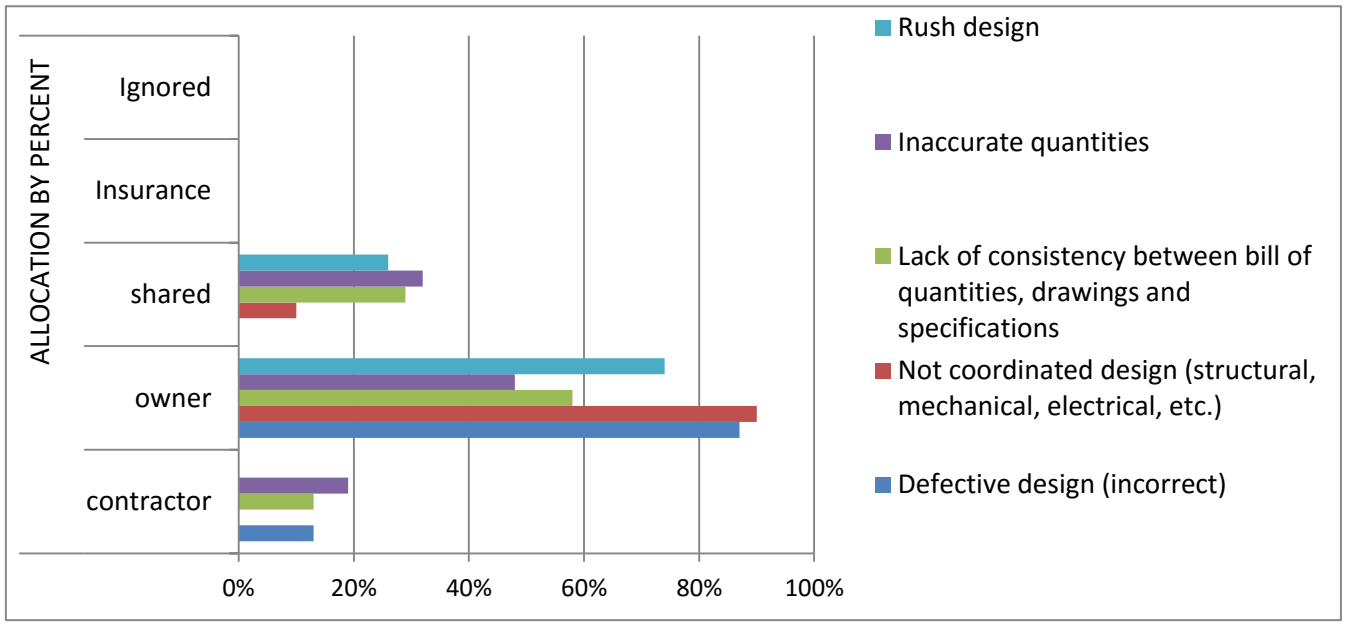
It has to be noted that contractors concerned about defective design issues because they could be responsible about any critical issues could happen due to incorrect design. Respondents assigned the risks of un-coordinated design and lack of coordination in design as high significance risks, on the other hand these risks can be overcome by paying true attention and coordinate correctly between design disciplines. Other design risk factors considered medium risks by contractors.

Allocation

Figure below illustrates that greater part of contractors allocate design risks onto owners.

Contractors had considered that owners should bear the risks of:

- ✓ Defective design (84%)
- ✓ Not coordinated design (87%)
- ✓ Inaccurate quantities (48%)
- ✓ Lack of consistency between bill of quantities, drawings and specifications (58%)



- ✓ Rush design (68%)**Figure 4.2.** Design group risks allocation, contractors' perspective

Major allocation percent's were heading towards owners who are in a better position to supply sufficient and accurate drawings on the design and services. Different professionals stated that the owner could best manage deficiencies in specifications and drawings by appointing a capable consultant and providing sufficient design budget.

4.2.3 Financial group

Severity

As seen in table (4.3) below, financial risks got the highest scores of surveyed risk factors given by contractor's respondents. Contractors considered the financial failure of contractor is the most sever risk in the financial group.

Table 4.3. Financial group risks

No	Financial Group Risks	SEVERITY
1	Financial failure of the contractor	high
2	Delayed payments on contract	high
3	Unmanaged cash flow	high
4	Inflation	medium
5	Exchange rate fluctuation	medium

Allocation

Figure below shows that contractors appear to be ready to bear the risks of:

- ✓ Financial failure of contractor (71%)
- ✓ Unmanaged cash flow (90%)

Majority of contractors (81%) allocated the delayed payments risk to the owners. This risk category is one of the most debated ones.

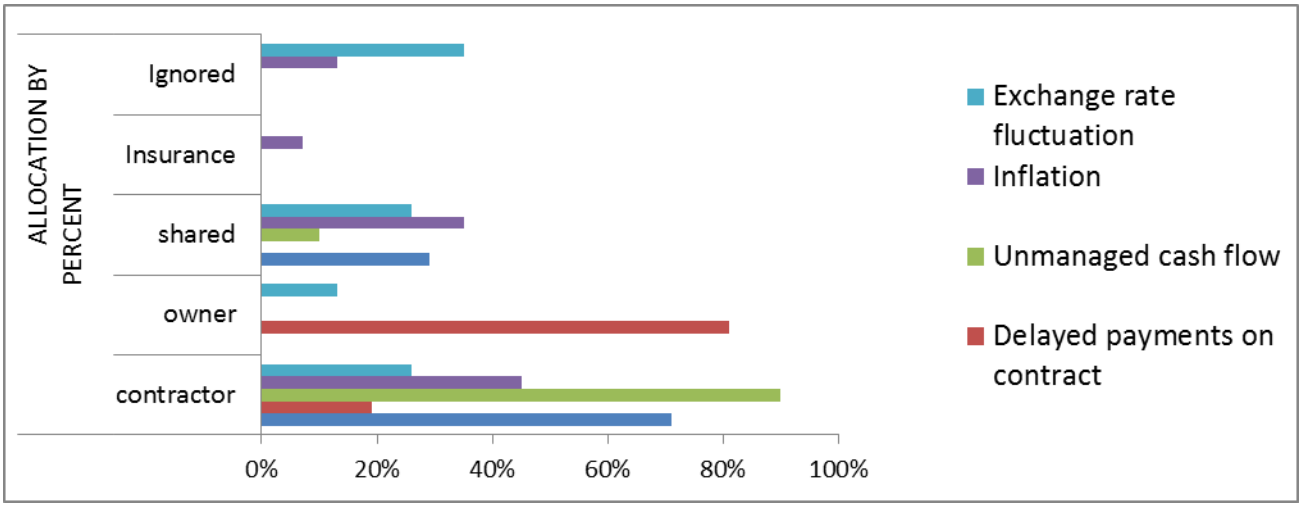


Figure 4.3. Financial group risks allocation, contractors' perspective

Contractor's respondents were undecided on who should take inflation risk, but from interviewing of the contractors they considered and suggested as it should be agreed by parties of the contracts in clauses to allocate such risks at the beginning in the bid. Even, the pre-bid meeting actions could contain such clauses. Contractors are considering this risk category as an oscillating risk category, where its threat increases when inflation increases, and vice versa. Contractors were undecided about exchange rate fluctuation.

4.2.4. Legal group

Severity

Table (4.4) shows that legal disputes, delayed disputes resolution and lack of specialized arbitrators had the highest weights in the legal group, which indicates the importance of dispute resolutions and the disputes' consequences. Difficulty to settle disputes between project parties. Ambiguity of work legislations came in the end.

Table 4.4. Legal risks

No	Legal Risks	SEVERITY
1	Legal disputes during the construction phase among the parties of the contract	high
2	Delayed disputes resolutions	high
3	No specialized arbitrators to help settle fast	medium
4	Ambiguity of work legislations	low

Figure below illustrates the allocation of legal group factors according to contractor's respondents. It is obvious that the greatest part of contractor respondent's deal with legal risks as shared risks. 58% of respondents dealt with ambiguity of work legislations as shared to. The greatest part of respondents (94%) preferred to share legal disputes and delayed resolution with owners. Disputes could originate due to mistake or misunderstanding by either party. Hence, these risks should really be shared risks.

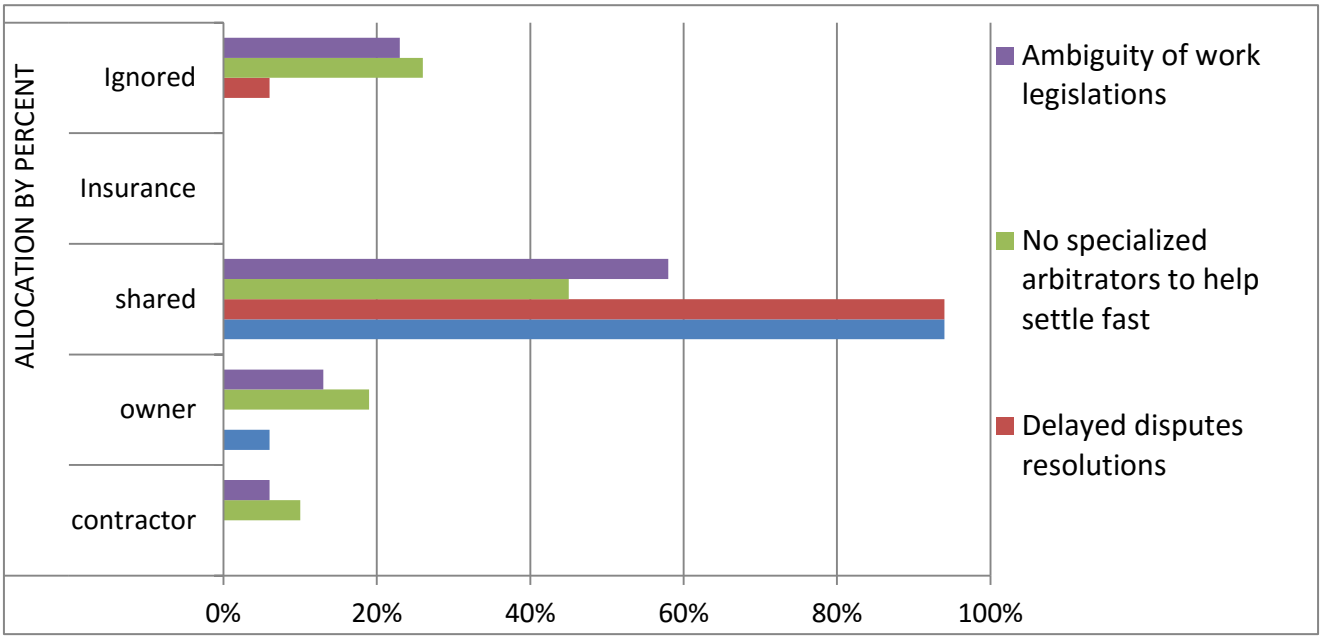


Figure 4.4.Legal group risks allocation, contractors' perspective

4.2.5 Construction group

Severity

In table (4.5) risks associated with construction were divided into two groups according to weights. The high importance group contained the risks of undocumented change orders, lower work quality and misunderstanding drawings and specifications respectively. Considering the risk of undocumented change orders as a high importance risk reflects a trend in which contractors are concerned with obtaining payment for a change in the work, since the cost impact of change orders cannot be claimed later.

Table 4.5. Construction group risks

No	Construction Group Risks	SEVERITY
1	Undocumented change orders	high
2	Lower work quality in presence of time Constraints	high
3	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	high
4	Design changes	medium
5	Actual quantities differ from the contract Quantities	medium
6	Rush bidding	medium

Contractors disturbed with the lower work quality, which means that contractors do their best to not have an abortive works, to maintain a good reputation and to avoid more costs repeating the abortive works. Other important risk is the risk of misunderstanding of drawings and specifications, this risk can cause significant work delays that are why contractors exhibit awareness towards this risk. Design changes, difference between actual and contract quantities and rush bidding were in the 4th, 5th and 6th places with medium severities, this reflects the little attention paid by contractors to these issues.

Allocation

Figure below shows the allocation of construction risks. Contractors accepted the risk of undocumented change orders (68%); contractors understand that the documentation of change order is their job. Majority of contractor respondents (68%) allocate the risks of rush bidding, design changes and difference between actual and contract quantities on the owner.

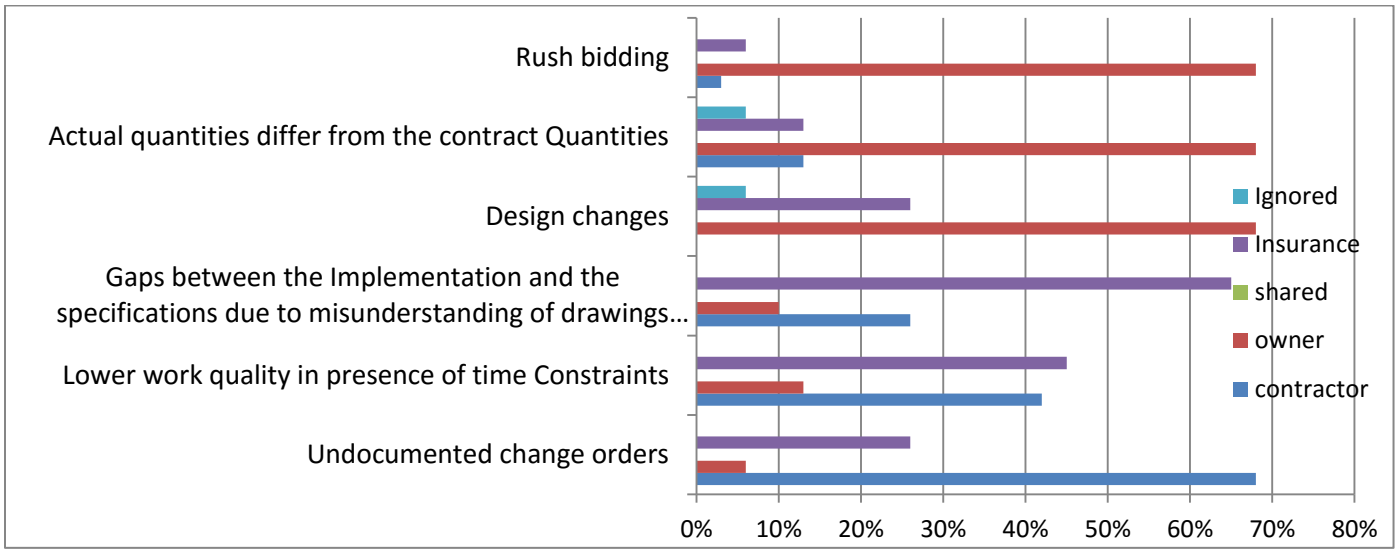


Figure 4.5. Construction group risks allocation, contractors' perspective

Allocating design changes risk category to the owner reflects a trend in which contractors are not very much concerned with changes in the work. Respondents were undecided about lower quality of work in presence of time constraints. It is thought that this risk category should be allocated to the contractor, since contractors are in a better position to control this risk.

4.2.6 Management group

Severity

Management group factors are listed in Table below as Poor communication between parties ranked first with high severity, the second was resource management with high severity, the project complexity severity was third and the fourth was changes in management ways with medium severity.

Table 4.6. Management group risks

No	Management Group Risks	SEVERITY
1	Poor communication between involved parties	High
2	Resource management	High
3	Ambiguous planning due to project complexity	Medium
4	Changes in management ways	Medium
5	Information unavailability (include uncertainty)	Medium

These indicated that the importance of management topics for contractors and indicates the existence of these risks, which need more and more applying management rules. Finally uncertainty with low severity. It is thought that management of projects need more and more training to properly manage projects specially the large ones.

Allocation

Figure below illustrates the respondents' allocation of management risks. Contractors seemed to be ready to accept the resource management and change in management ways risks with (68%) and (61%) respectively.

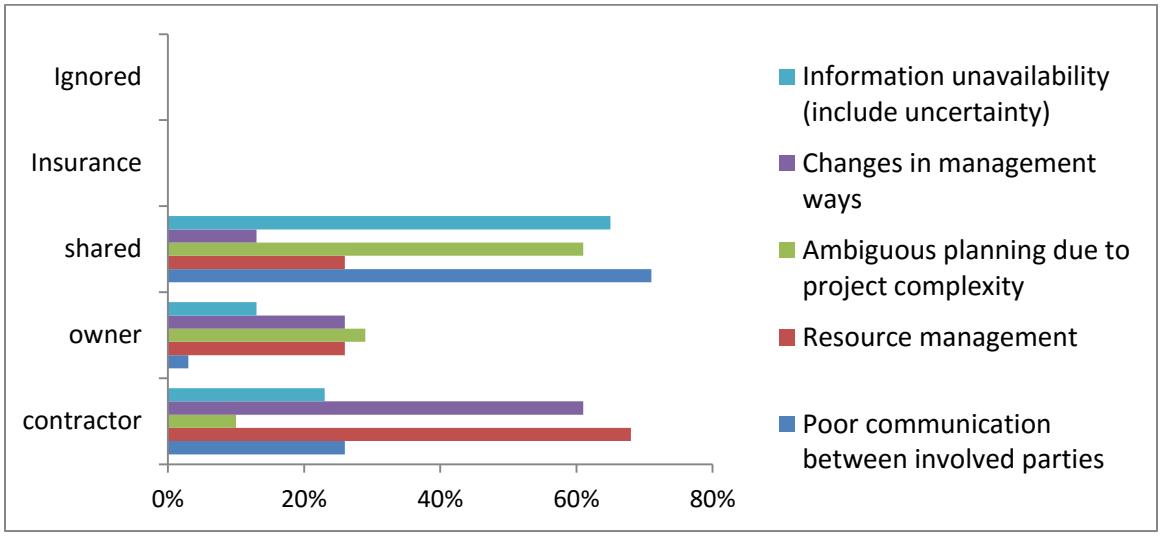


Figure 4.6. Management group risks allocation, contractors' perspective

It is predictable for contractor to deal with these risks. Contractor respondents decided to share ambiguous planning, uncertainty and poor communication risks with (61%), (65%) and (71%) respectively. These three issues should be really shared risks; it is the contractor's and owner's duty to put a clear plan for the project execution, to clarify any ambiguous information and to maintain a good communication manner in favor of project accomplishment

4.3 Overall risk consequence and allocation, contractors' perspective

Table (4.7) below shows risk factors included in the interview described based on degree of their occurrences.

Figure 4.7. Overall risk consequence and allocation, contractors' perspective

No	TYPES OF RISKS	DEGREE OF THEIR OCCURRENCES
1	Financial risks	Very often
2	Design risks	Often
3	Legal risks	Often
4	Construction risks	Often
5	Management risks	Sometimes
6	Physical risks	Sometimes

Allocation

The criterion for a risk to be appropriated to a particular category (contractor, owner, shared, insurance, or ignored), was that it should get at least a (60%) response rate. Those that failed to get such response rate in favor of any category were listed as undecided.

Allocation of risk factors included in the interview, according to the contractor's respondents, is appeared in Table (4.8) below. Contractors have allocated risks onto themselves, onto owners, as shared risks and as undecided risks. These results indicate that contracts' ignore the majority of risk factors.

Table 4.8. Risk allocation, Contractors' perspective

ALLOCATION	**RISK DESCRIPTION**
CONTRACTOR	Supplies of defective materials
	Varied labor and equipment productivity
	Financial failure of the contractor
	Unmanaged cash flow
	Undocumented change orders
	Resource management
	Changes in management ways
OWNER	Defective design (incorrect)
	Not coordinated design (structural, mechanical, electrical, etc.)
	Rush design
	Delayed payments on contract
	Rush bidding
	Design changes
	Actual quantities differ from the contract quantities
	Legal disputes during the construction phase among the parties of the contract
	Delayed disputes resolutions

SHARED	Ambiguous planning due to project complexity
	Information unavailability (include uncertainty)
	Poor communication between involved parties
UNDECIDED	Occurrence of accidents because of poor safety procedures
	Inaccurate quantities
	Lack of consistency between bill of quantities, drawings and specifications
	Inflation
	Exchange rate fluctuation
	Ambiguity of work legislations
	No specialized arbitrators to help settle fast
	Lower work quality in presence of time constraints

4.4 Risk management actions, from contractors' perspective

4.4.1 Preventive actions

According to the survey results as shown below, Contractors always depend on subjective judgment to produce a proper program is the most effective risk preventive actions. Judgment or subjective probability uses the experience gained from similar projects undertaken in the past by the decision maker to decide on the likelihood of risk exposure and the outcomes. Judgment and experience gained from previous contracts may become the most valuable information source for the use when there is limited time for preparing the project program. Construction, however, is subjected to a dynamic environment, that is why risk managers must constantly strive to improve their estimates. Even with near perfect estimates, decision making about risk is a difficult task.

Updated project information should be obtained and applied because depending only on experience and subjective judgment may not be enough, and therefore, contractors considered getting updated project information for effective risk preventive method. Adding risk premiums to time estimation at the project planning stage to be effective risk preventive method.

Table 4.9. Preventive methods, Contractors' perspective

I	**Preventive Methods**	**Preventive methods effectiveness, contractors' perspective**	
		Relative use needed	**By percent**
1	Depend on subjective judgment to produce a proper program.	Always	85
2	Produce a proper schedule by getting updated project information	Often	80
3	Consciously adjust for bias risk premium to time estimation	Often	80
4	Refer to previous and ongoing similar projects for accurate program	Sometimes	75
5	Transfer or share risk to/with other parties	Sometimes	70
6	Plan alternative methods as stand-by.	Rarely	55
7	Utilize quantitative risk analyses techniques for accurate time estimate.	Rarely	45

Make more accurate time estimation through quantitative risk analyses techniques such as using Primavera software program was not considered to be an effective preventive method for reducing the effects of risk. This is because of the risk analysis is largely based on the use of checklists by managers, who try to think of all possible risks. Referring to similar projects to for accurate program was recommended by the practitioners to be an effective preventive method.

4.4.2 Mitigative actions

The following table represents the six mitigative methods being proposed. The first mitigative method recommended by the respondents is close supervision to subordinates for minimizing abortive work. Increase working hours and coordinate closely with subcontractors were the second most effective mitigative methods for minimizing the impacts of delay.

Table 4.10. mitigative methods, Contractors' perspective

I	**MITIGATIVE METHODS**	**Mitigative methods effectiveness, contractors' perspective**	
		Relative use needed	**By percent**
1	Close supervision to subordinates for minimizing abortive work	Always	90
2	Increase the working hours	Often	85
3	Coordinate closely with Subcontractors	Often	85
4	Change the sequence of work by overlapping activities	Sometimes	75
5	Increase manpower and/or Equipment	Sometimes	72
6	Change the construction method	Rarely	58

Change the construction method was rarely used as a mitigative method. This could mean that the effort driven on site is one of the most important variables to project progress, since construction projects generally include many labor-intensive operations. In fact, as pointed out before, shortage of manpower in subcontractors' firms is one of the most serious risks to project delays. Therefore, increasing the work hours normally speeds up progress subject to the availability of materials and supervisors, physical constraints of the site, and construction sequence. And the last recommended mitigative method is change the construction method.

4.5. Use of risk analysis techniques by contractors

The table below explains the data obtained from interview of contractors of risk analysis techniques.

Table 4.17 Risk analysis techniques

No	**Analysis Techniques**	**By percent**
1	Direct judgment using experience and personal skills	80
2	Comparing analysis (compare similar projects through similar conditions)	75
3	Probability analysis (analyze historical data)	65
4	Expert Systems (including software packages, decision support systems, computer-based analysis techniques	50
5	Sensitivity analysis	40
6	Simulation analysis using simulator computer packages	30

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The construction industry has characteristics that sharply distinguish it from other sectors of the economy. It is fragmented, very sensitive to economic cycles, and highly competitive because of the large number of firms and relative ease of entry. It is basically due to these unique characteristics considered a risky business.

In this study, identifying the risk factors faced by construction industry is based on collecting information about construction risks, their consequences and corrective actions that may be done to prevent or mitigate the risk effects. Risk analysis techniques were investigated too. However, determination of severity and allocation of these risk factors was the main result of this research.

Contractors and owners still depend on traditional approaches to manage risk factors and their consequences; the use of direct judgment to control risk factors was the most applied method used to control risk events.

Risk management helps the key project participants – client, contractor or developer, consultant, and supplier to meet their commitments and minimize negative impacts on construction project performance in relation to cost, time and quality objectives. An effective risk management method can help to understand not only what kinds of risks are faced, but also how to manage these risks in different phases of a project.

The focal point of this research is to explore the key risk factors and identify these factors that could be faced in construction industry in Addis Ababa. Analysis of these risk factors was carried out to measure their effects on building projects and to assign each risk factor on the party who is in the best position to handle such situations. The risk factors that were identified are shown in Table

(2.1). These factors were investigated to measure the severity of each. The most ten sever risk factors are appeared in Table (5.1).

Table 5.1. Most ten sever risk factors and allocation according to contractors

Rank	Risk Description	Allocation
1	Financial failure of the contractor	Contractor
2	Inflation	Undecided
3	Closure(Termination)	Shared
4	Defective design (incorrect)	Owner
5	Delayed payments on contract	Owner
6	Legal disputes during the construction phase among the parties of the contract	Shared
7	Resource management	Contractor
8	Poor communication between involved parties	Shared
9	Unmanaged cash flow	Contractor
10	Occurrence of accidents because of poor safety procedures	Contractor

5.2 Conclusions from this thesis work

1. Shortage of skillful workers is the major risk faced by almost all the companies. This is because; the skilled workers are migrating between companies very often due to the high demand in the market.
2. Since construction sectors are in the boom side, construction companies are in move to make profit as soon as possible in current wave itself; but this creates tremendous pressure to the workers to complete the project in a very short span. This time constraint risk prevails in all the companies surveyed.
3. Sub-contractor related risks are also high, since most of the sub-contractors are not able to

meet the standards of the main contractor and the client due their size of work. Thus from the above points the management risk has been found to be the critical risk from this survey

4. Delay in the project is also one of the main risks, but this delay is looped with various others factors and risks directly or indirectly.
5. The risk of competition from other companies constitutes major problem to the small & medium sized companies. Due to the policy of the Ethiopian government that 100% FDI is allowed in the construction sector which allowed foreign companies to enter the market, created a stiff competition to the local companies both technically and financially.
6. Inflation rate is very high in the country and increasing proportionately with time, this causes the increase in prices of materials like cement, steel which in turn causes financial risk to the land developers and construction firms. Banks have also raised their interest rates for the loan given by them, this have affected the construction market hugely. Thus the financial part of risk is very high than any other risk.
7. Political risk is substantially very low for the large firms when compared to other risk.
8. Legal risk is also very low, but the implementation of court directive is not proper; this was the complaint seen from this survey.
9. Large companies are accepting that there are few environmental effects due to their project, but says that it is a global phenomena and it can not be nullified, but only can be reduced.
10. Overall market, management, and the financial risks are high when compared to other risks.

5.3 Recommendations to contractors

- ✓ Contracting companies should compute and consider risks by adding a risk premium to quotation and time estimation. This trend has to be supported by organizations concerned about the construction industry.
- ✓ Contractors should struggle to prevent financial failure by practicing a strict cash flow management and minimizing the dependence on bank loans.
- ✓ Contractors should learn how to share and shift different risks by hiring specialized staff or specialized sub-contractors.
- ✓ Contracting firms should utilize computerized approaches used for risk analysis and evaluation programs like Microsoft Project and Microsoft Excel.
- ✓ Financial part of the risk is a global phenomenon and this risk should be handled carefully using financial consultants since this cannot be handled by engineers alone.
- ✓ Most of the company's management follow Top to down approach which is a traditional approach, but Down to top approach should be followed so that the employees' voices are heard.
- ✓ It is better to involve a risk consultant in a project who can both owner and the contractor in a better way.
- ✓ Moreover, contractors should work on training their personnel to properly apply management principles. It is the duty of institutes to provide such training.

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APPENDIX:- QUESTIONNAIRE

ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY

DEPARTMENT OF BUSINESS ADMINISTRATION

Dear Respondent,

My name is Ermias Hailu. I am a graduate student at Addis Ababa science and Technology University. I am conducting a research entitled "Risks and Risk management in building construction projects from contractors perspective in Addis Ababa*"* for my partial fulfillment of the requirements for the degree of Masters of Business Administration. Hence, I am courteously requesting you to provide me your personal cooperation by filling the questionnaire, which will take you 15-20 minutes. The main purpose of this questionnaire is to gather relevant data to investigate and allocate key risks of construction project from contractors side of Addis Ababa in general.

Therefore, I am courteously requesting you to fill up carefully and return the questionnaire. The genuine, honest and reliable response you provide is invaluably important to successfully accomplish the study. Your response is used only for the successful accomplishment of this study; hence confidentiality is very respected as well as anonymity is implemented. I thank you for your time, co- operation and concern.

Notice:

1. You do not need to write your name on this questionnaire.
2. Please, follow the general directions given and respond accordingly.

Thank you in advance for your co-operation.

Ermias Hailu Woldemarriam

PART 1: RESPONDENT'S ORGANISATIONAL PROFILE

1. The position and grade of the respondent? _____
2. Is there any specialized staff or unit responsible for risk management process in your organization? _____
3. Is there any guidance or manual prepared by contractors for risk management process? _____
4. Have you used any risk assessment techniques/ plans based on your experience? _____

PART 2: RISK FACTORS SEVERITY AND ALLOCATION

Below is the table which contains the risk factors, please assign the severity of each factor, and allocate on each one of the parts shown. Tick in the box below.

1. PHYSICAL RISK FACTORS.

	RISK FACTORS	**SEVERITY**			**ALLOCATION**				
I	**Physical**	Low risks	Medium risks	High risks	contractor	owner	shared	Insurance	Ignored
1	Occurrence of accidents because of poor safety procedures								
2	Supplies of defective materials								
3	Varied labor and equipment productivity								

2.DESIGN RISK FACTORS.

	RISK FACTORS	**SEVERITY**			**ALLOCATION**				
III	**Design**	Low risks	Medium risks	High risks	contractor	owner	shared	Insurance	Ignored
1	Defective design (incorrect)								
2	Not coordinated design (structural, mechanical, electrical, etc.)								
3	Inaccurate quantities								
4	Lack of consistency between bill of quantities, drawings and specifications								
5	Rush design								

3. FINANCIAL RISK FACTORS

	RISK FACTORS	**SEVERITY**			**ALLOCATION**				
V	**Financial**	Low risks	Medium risks	High risks	contractor	owner	shared	Insurance	Ignored
1	Inflation								
2	Delayed payment on contract								
3	Financial failure of the contractor								
4	Unmanaged cash flow								
5	Exchange rate fluctuation								

4. LEGAL RISK FACTORS.

	RISK FACTOR	**SEVERITY**			**ALLOCATION**				
VI	**Legal**	Low risks	Medium risks	High risks	contractor	owner	shared	Insurance	Ignored
1	Ambiguity of work legislations								
2	Legal disputes during the construction phase among the parties of the contract								
3	Delayed disputes resolutions								
4	No specialized arbitrators to help settle fast								

5. CONSTRUCTION RISK FACTORS.

	RISK FACTORS	**SEVERITY**			**ALLOCATION**				
VII	**Construction**	Low risks	Medium risks	High risks	contractor	owner	shared	Insurance	Ignored
1	Rush bidding								
2	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications								
3	Undocumented change orders								
4	Lower work quality in presence of time Constraints								
5	Design changes								
6	Actual quantities differ from the contract Quantities								

6. MANAGEMENT RISK FACTORS

No	**RISK FACTORS**	**SEVERITY**			**ALLOCATION**				
		Low risks	Medium risks	High risks	contractor	owner	shared	Insurance	Ignored
1	Ambiguous planning due to project complexity								
2	Resource management								
3	Changes in management ways								
4	Information unavailability (include uncertainty)								
5	Poor communication between involved parties								

7. Based on your experiences in risks happened in construction industry, please tick in the box below according to degree of their occurrences.

Risk types	DEGREE OF OCCURANCES				
	Very often	Often	Sometimes	Rarely	Never
a) Physical risks.					
b) Design risks.					
c) Financial risks.					
d) Legal risks.					
e) Construction risks.					
f) management risks					

PART 3: REMEDIAL METHODS (PREVENTIVE AND MITIGATION METHODS)

1. In the table shown below, please determine the relative use of each preventive method in the table.

		Never	Rarely	Sometimes	Often	Always
I	**PREVENTIVE METHODS**					
1	Utilize quantitative risk analyses techniques for accurate time estimate.					
2	Depend on subjective judgment to produce a proper program.					
3	Produce a proper schedule by getting updated project information					
4	Plan alternative methods as stand-by.					
5	Consciously adjust for bias risk premium to time estimation					
6	Transfer or share risk to/with other parties					
7	Refer to previous and ongoing similar projects for accurate program					

2. In the table shown below, please determine the relative use of each mitigate method in the table.

		Never	Rarely	Sometimes	Often	Always
I	**MITIGATIVE METHODS**					
1	Increase manpower and/or equipment					
2	Increase the working hours					
3	Change the construction method					
4	Change the sequence of work by overlapping activities					
5	Coordinate closely with subcontractors					
6	Close supervision to subordinates for minimizing abortive work					